UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
CHEMICAL SAFETY AND
POLLUTION PREVENTION

MEMORANDUM:

To: Kable Davis, MS, PM 03

From: Eric W. Bohnenblust, Ph.D., Entomologist

Secondary Review: Jennifer Saunders, Ph.D., Senior Biologist

Date: 5/30/2017

Subject: PRODUCT PERFORMANCE DATA EVALUATION RECORD (DER)

THIS DER DOES NOT CONTAIN CONFIDENTIAL BUSINESS INFORMATION

Note: MRIDs found to be **unacceptable** to support label claims should be removed from the data matrix.

DP barcode: 305083
Decision no.: 335418
Submission no: 763457
Action code: 194
Product Name: Talstar 2.4% ME Insecticide/Miticide
EPA Reg. No or File Symbol: 279-3218
Formulation Type: Liquid concentrate
Ingredients statement from the label with PC codes included:
Bifenthrin 2.4% PC: 128825
Application rate(s) of product and each active ingredient (lbs. or gallons/1000 square feet or per acre as appropriate; and g/m^2 or mg/cm^2 or mg/kg body weight as appropriate): For termite applications: 1 quart of product makes 10 gallons of diluted solution (0.06% Bifenthrin) and covers 25 linear feet per foot of depth; for other pest and application types dilute 3.2 fl. oz. product into 1 gallon of water, one gallon of diluted solution covers 1000 ft^2
Use Patterns: Only for outdoor uses including crack and crevice treatments, barrier applications, lawn and turf broadcast treatments, and post construction applications to building foundations for termites

I. Action Requested: Review data submitted as a condition of registration to support efficacy claims for up to 5 years against termites.

II. Background: These data, MRID 46272801, were submitted in 2004 in response to an EPA letter dated 13 November 2003 and a follow-up meeting on 10 February 2004 between EPA and FMC. Efficacy of EPA Reg. No. 279-3218 against termites is also supported by MRIDs 41639201, 41753401, 42181301; however, these three MRIDs were determined to not be sufficient to support 5 year efficacy claims.

III. MRID Summary: (primary review is attached)

46272801. Efficacy and Degradation of Bifenthrin in the Soil for Insect Control.

(1) non-GLP

(2) **Methods:** This MRID contains six different studies, each reviewed individually below.

Study 1: Comparison of Eleven Soil Termiticides Against the Formosan Subterranean Termite and Eastern Subterranean Termite (Su and Scheffrahn, 1991; corresponds to Appendix 1 in MRID 462728-01).
This is a published manuscript containing two studies: One tested 0, 0.01, 0.1, 1, 10, 100, and 1000 ppm solutions of chlordane, chlorpyrifos, permethrin, cypermethrin, fenvalerate, bifenthrin, cyhalothrin, esfenvalerate, silaneophane, tralomethrin, and deltamethrin for efficacy against *Reticulitermes flavipes* and *Coptotermes formosanus*. Twenty termites of each species were topically exposed to 0.5 µl of one solution in the lab using a pipette and then assessed for mortality for three days. The second laboratory study evaluated penetration by termites in soil treated with 0, 0.01, 0.1, 1, 10, and 100 ppm solutions of the same active ingredients as in the first study. Five centimeters of treated soil were placed between two agar discs. Eighty workers and one soldier were introduced to each soil section and observations of the vertical penetration and termite mortality were conducted daily for up to 1 week.

Study 2: Termiticide Soil pH Study.
Researchers assessed residues of permethrin, bifenthrin, and cypermethrin in soil with pH levels of 6 and 8 for two years. Soil was treated with 800 mg active ingredient in a 500 ppm solution. Soil samples were centrifuged and then chemical components were identified using High-Performance Liquid Chromatography (HPLC). This study did not evaluate efficacy of the residues against termites.

Study 3: Degradation of bifenthrin, chlorpyrifos, and imidacloprid in soil and bedding material at termiticidal application rates. (Baskaran et al., CSIRO Land and W#ater Group, 1999; corresponds to Appendix 3 in MRID 462728-01).
This published manuscript documented degradation of bifenthrin, chlorpyrifos, and imidacloprid in soil and bedding materials for up to two years. Bifenthrin was applied to soil at 100 mg/kg. In addition to degradation under ambient conditions, the researchers also evaluated the effect of moisture on degradation of the three active ingredients. Residue levels were assessed using HPLC every four months for two years. No efficacy data were presented to determine if residues were biologically active against termites.

Study 4: Persistence and Bioavailability of Soil Treatments Against the Desert Subterranean Termite Heterotermes aureus in Arizona. University of Arizona Draft Publication (corresponds to Appendix 4 in MRID 462728-01).
Field plots in Arizona were treated with the following termiticide treatments on a w/w basis: permethrin at 0.5% and 0.25%, cypermethrin at 0.25%, bifenthrin at 0.06%, zeta-cyprmethrin at 0.125%, imidacloprid at 0.05%, and chlorpyrifos at 1% and 0.75%. Plots were established using the USDA Gulfport design. Soil cores were extracted from each plot at 0, 6, 12, 24, 36, 48, and 60 months post application. All samples were tested for bifenthrin residues using HPLC and cores from 24-60 months were utilized for laboratory bioassays to evaluate mortality and repellency (tunnel prevention) against *Heterotermes aureus*. Twenty-three workers and two soldiers were introduced into the top of glass tubes which contained treated or untreated soil and a sliver of wood. Each treatment was replicated three times.

Study 5: Summary Report after nine years of field trials installed in Australia at Beerburrum, Queensland State Forest 589, with bifenthrin (FMC 54800) as a soil barrier against subterranean termites. Runko,, CSIRO Entomology, 2004 (corresponds to Appendix 5 in MRID 462728-01).
This field study evaluated efficacy against termites of solutions containing bifenthrin at 0.025%, 0.05%, 0.075%, 0.1%, 0.15%, 0.2%, and 0.3% as vertical and horizontal barrier treatments. An untreated control was included. Field trials were setup in Brisbane, Australia, where the predominant termite species was *Coptotermes acinaciformis*. See attached primary DER for additional detailed methods.

Study 6: Summary report after fifteen years of field trials installed in southern Australia at Binya, State Forest, NSW, with bifenthrin (FMC 54800) as a soil barrier against subterranean termites. Runko., CSIRO Entomology. 2004 (corresponds to Appendix 6 in MRID 462728-01).
This field study evaluated efficacy against termites of solutions containing bifenthrin at 0.05%, 0.15%, 0.3%, and 0.5% as vertical barrier treatments for 15 years. An untreated control was included. These trials were conducted in Australia where the most common termite species were *Coptotermes acinaciformis*, *Heterotermes ferox* complex,

and *Schedorhinotermes reticulatus*. See attached primary DER for additional detailed methods.

(3) **Results:**

Study 1: In the topical toxicity test, the LD_{50} for *C. formosanus* was 0.73 µg bifenthrin/g body weight and for *R. flavipes* was 0.06 µg bifenthrin/g body weight. Control mortality was less than 10%. In the penetration test, applying 1 ppm or greater completely prevented tunneling through 1 week post exposure, however mortality never consistently reached 90% with any of the tested solutions. This study does not support efficacy claims against soil pests for up to 5 years because efficacy was only tested in the laboratory for 1 week. Also, tested rates cannot be directly compared to the labeled rate.

Study 2: The percentage of bifenthrin remaining in soil at pH 6 was 81% ± 3.4 at 24 months post application. For soil at pH 8, 66.3% ± 13.2% of bifenthrin remained at 24 months post application and retention was 79% or higher through 20 months post application. No efficacy data were presented to determine if the amount of bifenthrin was effective at killing or repelling termites. This study does not support efficacy claims against termites for up to 5 years because data were only provided for two years and no efficacy data were provided to show that the residues which remained were biologically active against termites.

Study 3: Residues of bifenthrin remaining in the soil were > 75% of the initial application rate through 2 years after application. Soil moisture had little to no effect on retention of bifenthrin residues in soil. This study does not support efficacy claims against soil pests for up to 5 years because data were only provided for two years and no efficacy data were provided to show that the residues which remained were biologically active against termites. In addition, the tested application rate cannot be directly compared to the labeled application rate.

Study 4: Only data for the bifenthrin treatment are reported below. Immediately after application, bifenthrin residues were measured at 91 ppm. Residues steadily declined through 5 years post application when 6% of the original residues remained in the soil. At 12 months post application 54% of residues remained in the soil, at 24 months 33% remained, at 36 months 31% remained, and at 48 months only 8% of residues were detected in the soil. In the laboratory tests, mortality of H. aureus was 100% in soil collected at 2 years post application, but was less than 83% during years 3 – 5 post application. Mortality in the control treatment was 11% at 24 months post application, 20% at 36 months post, 41% at 48 months post, and 32% at 60 months post application. Tunneling observed in the laboratory, was completely inhibited in soil samples from 2-4 years old, but in five-year-old samples tunneling was only reduced by 50% when compared to the control treatment. This study does not support efficacy claims against termites for five years because these are laboratory studies, mortality was only over 90% through 2 years post application, and tunneling was only inhibited through 4 years post application. Also, the volume of 0.06% bifenthrin applied in the study is unclear and cannot be directly compared to the labeled rate on amount of active ingredient/unit area or linear ft. basis. In addition, mortality in the control treatment was high and no explanation was provided to explain the high mortality in the control treatment.

Study 5: In the vertical barrier test, the solution containing 0.025% bifenthrin did not provide acceptable efficacy (17% of uncovered plots had termite damage) after one year. In uncovered plots treated with the 0.05% bifenthrin solution, zero plots had any damage through 5 years post application; however, at 6 years post application 17% of plots had termite damage. All other treatments provided 100% control through 9 years post treatment. For all years, at least 75% of untreated, uncovered control plots were penetrated by termites in the vertical barrier test. In the horizontal barrier treatment test, the 0.025%, 0.05%, 0.075% and 0.10% bifenthrin treatments showed 100% control through 5 years post application and failed at 6 years post application with 17-33% of plots showing termite damage. The plots treated with bifenthrin concentrations over 0.75% showed 100% control through at least 8 years post application. The percentage of control plots with termite penetration was less than 55% during years 1, 4 and 5 post application but between 71-75% during years 2 and 3. This study is supplemental but does not by itself support efficacy claims for up to 5 years for the proposed product. This study cannot support efficacy claims because testing was performed in Australia against a termite species which is not present in the United States. Termiticide efficacy testing should be conducted in the United States with termite species present in the US.

Study 6: All four bifenthrin treatments provided 100% control of termites for 11 years post treatment and the 0.15%

treatment provided 100% control through 15 years after treatment. In year 12, termites penetrated one plot in the 0.05% bifenthrin treatment, and one plot in each of the 0.3% and 0.5% treatments in year 13 post treatment. This study is supplemental and does not by itself support efficacy claims for up to 5 months for the proposed product. This study cannot support efficacy claims because testing was performed in Australia against a termite species which is not present in the United States. Termiticide efficacy testing should be conducted in the United States with termite species present in the US.

(4) **Conclusion: Supplemental.** The data in studies 5 and 6 show efficacy of bifenthrin against termites for between 5 and 12 years. However, no justification was provided in the MRID for bridging data collected with Australian species to support efficacy claims against termite species in the US. Studies 1-4 in this MRID do not show efficacy against termites for five years.

IV. EXECUTIVE DATA SUMMARY:

(A) Studies 5 and 6 in MRID 46272801 are sufficient only in combination with MRIDs 41639201, 41753401, 42181301 to support efficacy of the current outdoor perimeter barrier treatment (per label dated June 30, 2011) against termites at the 0.06% dilution (3.2 fl. oz. product per gallon of water per 2.5 linear foot per foot of depth) for up to 5 years.

V. LABEL RECOMMENDATIONS:

(1) No changes are needed for the Directions for Use.

(2) The following marketing claims are acceptable:
Keeps termites away for up to 5 years in areas treated

(3) The following marketing claims are unacceptable: N/A

(4) The following MRIDs should be removed from the data matrix, as they are classified as "unacceptable" to support the product: N/A

TASK 2 DATA EVALUATION RECORD

STUDY TYPE: Product Performance

MRID 462728-01. Mares, J.T. Efficacy and Degradation of Bifenthrin in Soil for Insect Control. May 4, 2004.

OCSPP 810.3600: Structural Treatments

Product Name: Talstar
EPA Reg. No. or File Symbol: 279-3218
Decision number: 335418
DP number: 305083

Prepared for
Registration Division (7505)
Office of Pesticide Programs
U.S. Environmental Protection Agency
Washington, DC 20460

Prepared by
Summitec Corporation
Task Order No.: 2-229

Primary Reviewer:
Dennis M. Opresko, Ph.D. Signature: _____
Date: _____

Secondary Reviewers:
Robert H. Ross, M.S. Signature: _____
Date: _____

Robert H. Ross, M.S. Program Manager Signature: _____
Date: _____

Quality Assurance:
Angela M. Edmonds, B.S. Signature: _____
Date: _____

Disclaimer

This review may have been altered subsequent to the contractors' signatures above.
Summitec Corp. for the U.S. Environmental Protection Agency under Contract No. EP-W-11-014

DATA EVALUATION RECORD

[EPA Primary Reviewer's Name] _____

STUDY TYPE:	OCSPP 810.3600: Structural Treatments
MRID:	**462728-01**. Mares, J.T. Efficacy and Degradation of Bifenthrin in Soil for Insect Control. May 4, 2004.
DP BARCODE:	305083
DECISION NO:	335418
SUBMISSION NO:	Not included on Assignment Sheet
SPONSOR:	FMC Corporation Agricultural Products Group Specialty Products Business 1735 Market Street Philadelphia, PA 19103
TESTING FACILITY:	Not applicable; literature review
STUDY DIRECTOR:	J.T. Mares FMC Corporation
SUBMITTER:	G. Meindl FMC Corporation
STUDY COMPLETED:	4/05/2004 (date of report)
CONFIDENTIALITY CLAIMS:	None
GOOD LABORATORY PRACTICE:	This study reported herein "Efficacy and degradation of bifenthrin in soil for insect control," FMC Corporation, PDM 056-04, was **NOT** conducted and reported in compliance with the Good Laboratory Practice Standards set forth in Title 40, Part 160 of the Code of Federal Regulations of the United States of America. Quality Assurance did not audit this study.

TEST MATERIAL:

PRODUCT NAME: Talstar
EPA REGISTRATION NUMBER OR FILE SYMBOL: 279-3218
ACTIVE INGREDIENT NAMES: Bifenthrin
CHEMICAL NAME: Not given
A.I. %: 2.4%
PC CODES: Not given.
CAS NO.: Not given.
FORMULATION TYPE: Liquid Concentrate
PRODUCT APPLICATION RATE(S):

- Termites: 3.2 fl oz (6 1/2 Tbs.) per gallon of water for each 2 1/2 linear feet of trench
- All other listed pests: 0.5 fl oz (1 Tbs.) per gallon of water sprayed over 167 sq. ft.

4 gallons of emulsion per 10 linear feet per foot of depth
ACTIVE INGREDIENT APPLICATION RATE(S): Not reported.

PROPOSED LABEL MARKETING CLAIMS:

KEEPS TERMITES AWAY FOR UP TO 5 YRS IN AREAS TREATED*
Kills...termites.
Kills and control subterranean termites.

STUDY REVIEW

Purpose: MRID 462728-01 for Task 2-229 discusses six published and unpublished reports on the efficacy against termites and soil degradation of bifenthrin and other insecticides. The complete reports are included in the MRID as Appendices. Some of the reports are solely on degradation, others contain both degradation and efficacy data. The information in all the six reports is summarized at the beginning of the MRID. This DER presents a summary of bifenthrin efficacy data as well as the author's and submitter's conclusions.

REVIEWER'S NOTE:
Label dilution rate is: 3.2 fl. oz./gal; 3.2 x 29.57 ml = 94.62 mL x 2.4% = 2.27 mL A.I.
2.27 mL/in 1 gal (3785 mL) = **0.0006 or 0.06% A.I. v/v.**

Label application rate is: 12.8 fl. oz. per 10 linear ft per 1 ft depth and 0.5 ft width.
12.8 fl. oz. = 378.5 mL = 378.5 cc [or 378.5 gm assuming a density of 1 g/mL].
Trench is 304.8 cm x 15.24 cm x 30.48 cm= 141584.23 cc
Therefore:
378.5 cc/141584.23 cc = 0.00267 x 2.4% A.I. = 0.000064 = 0.0064 % A.I v/v **or 64 ppm A.I. v/v.**

OR: 378.5 gm/3.048 m x 0.152 m x 0.305 m = 378.5 gm/0.1413 m^3 = 2678.6 gm/m^3 x 2.4% A.I.= **64.3 gm A.I. /m^3**.

STUDY 1: Comparison of Eleven Soil Termiticides Against the Formosan Subterranean Termite and Eastern Subterranean Termite (Su and Scheffrahn, 1991; corresponds to Appendix 1 in MRID 462728-01).

Summary of Efficacy Data

Finally, bifenthrin is extremely active against termites at very low rates. Su and Scheffrahn (1990) determined the topical toxicity of various compounds including bifenthrin against two species of subterranean termites. Bifenthrin was found to have an LD_{50} of 0.73ug/g termite body weight for *Coptotermes formosanus* and 0.06ug/g termite body weight for *Reticulitermes flavipes*. Additionally, Su and Scheffran found that these termite species were impeded from penetrating soil treated with bifenthrin at concentrations of 6 ppm or less.

Table 1. Response of *C. formosanus* and *R. flavipes* to selected termiticides

Termiticide[a]	*C. formosanus*				*R. flavipes*			
	Mean body wt. (mg/worker ± SE)	n	Slope ± SE	LD_{50} (95% FL)[b]	Mean body wt. (mg/worker ± SE)	n	Slope ± SE	LD_{50} (95% FL)[b]
CLD	3.7 ± 0.3	452	0.046 ± 0.006	45.54 (40.01–50.07)	2.4 ± 0.1	486	0.074 ± 0.016	10.10 (12.83–24.73)
SIL	3.5 ± 0.5	580	0.258 ± 0.029	5.94 (4.46–5.83)	2.4 ± 0.1	295	3.010 ± 0.309	0.95 (0.86–1.03)
CPF	3.5 ± 1.1	406	0.613 ± 0.068	2.89 (2.59–3.56)	2.3 ± 0.1	388	1.195 ± 0.104	1.74 (1.58–1.89)
FNV	3.3 ± 0.9	542	0.579 ± 0.056	2.14 (1.66–2.52)	2.4 ± 0.1	433	4.840 ± 0.424	0.49 (0.37–0.44)
PER	3.4 ± 0.7	408	0.835 ± 0.096	2.03 (1.77–2.26)	2.3 ± 0.1	466	2.970 ± 0.451	0.62 (0.54–0.72)
BIF	3.4 ± 1.0	531	1.994 ± 0.228	0.73 (0.66–0.81)	2.3 ± 0.1	406	19.517 ± 4.083	0.06 (0.04–0.66)
CYP	3.4 ± 0.9	550	1.771 ± 0.155	0.64 (0.57–0.71)	2.3 ± 0.1	618	7.642 ± 0.966	0.13 (0.10–0.15)
SNV	3.5 ± 0.9	513	2.351 ± 0.373	0.56 (0.47–0.64)	2.4 ± 0.1	540	14.598 ± 3.567	0.09 (0.06–0.11)
CYH	3.7 ± 0.4	448	6.559 ± 0.808	0.29 (0.25–0.32)	2.4 ± 0.0	311	33.299 ± 8.700	0.04 (0.03–0.05)
TRL	4.4 ± 1.1	404	13.610 ± 1.573	0.14 (0.13–0.16)	2.3 ± 0.1	526	118.814 ± 12.001	0.04 (0.03–0.04)
DLT	3.9 ± 0.3	580	11.890 ± 1.166	0.12 (0.11–0.14)	2.3 ± 0.1	366	244.274 ± 24.076	0.01 (0.01–0.11)

[a] CLD, chlordane; SIL, silaneophane; CPF, chlorpyrifos; FNV, fenvalerate; PER, permethrin; BIF, bifenthrin; CYP, cypermethrin; SNV, esfenvalerate; CYH, cyhalothrin; TRL, tralomethrin; DLT, deltamethrin.
[b] Dose is μg/g body weight.

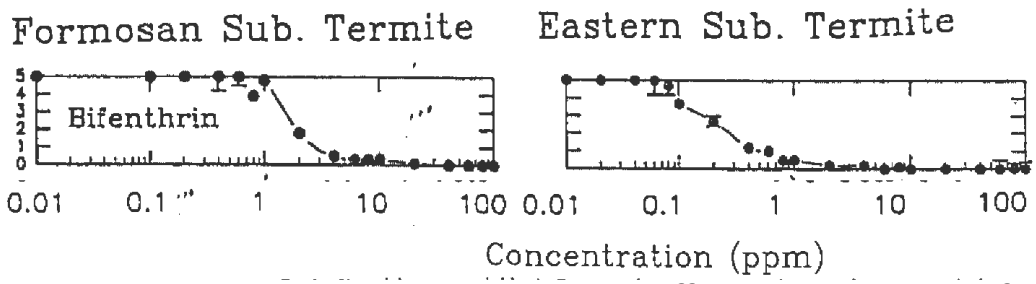

Figure 1. Distance tunneled by termites (cm) at different concentrations of bifenthrin.

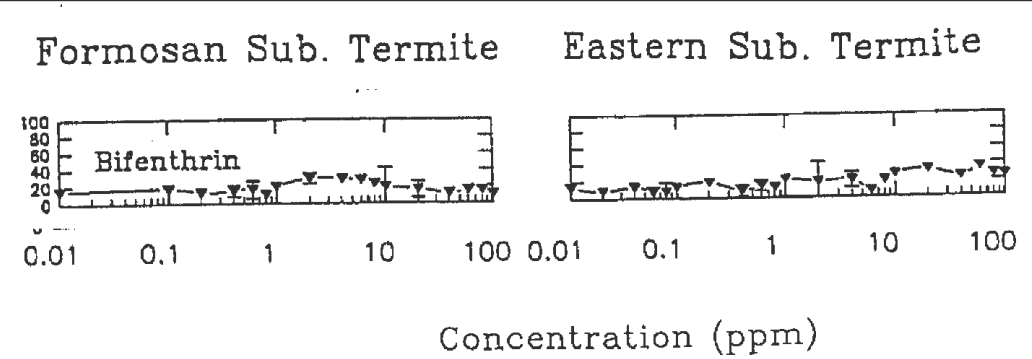

Figure 2. Mortality of termites at different concentrations of bifenthrin one week after being placed in tunneling tubes.

The ppm soil concentrations of bifenthrin tested were expressed on a weight/weight basis. The soil penetration tests were 1 week in duration.

Author's Conclusions

Repellency of pyrethroids was clearly demonstrated in termites exposed to silaneophane, fenvalerate, bifenthrin, or cypermethrin. No significant mortality of either species was recorded for any concentration tested (Fig. 2). At higher concentrations, termites avoided soil treated with these pyrethroids. They penetrated the soil only when the concentration was below mortality thresholds. The concentration thresholds for repellency were apparently lower than those that induced mortality after termites encountered the treated soil.

Submitter's Conclusions

Bifenthrin remains repellent to termites at concentrations as low as 5 ppm in soil. At this concentration, termites will only partially tunnel through treated soil, and most of the termites that attempt to penetrate the treated soil are killed.

Reviewer's Conclusions

Data presented supports the conclusions of the study author and the submitter. Bifenthrin prevented termites from tunneling through soil at a concentration of about 6 ppm and higher (Note: the submitter incorrectly states that tunneling is prevented at a concentration "of 6 ppm or less").

Reviewer's Recommendation

The proposed label indicates application rates on a volume per volume basis, whereas in the study bifenthrin soil concentrations were expressed on a weight per weight basis; therefore, a direct one to one correspondence is not possible unless the density of the product and that of the soil are known. Nevertheless, because the initial label application rate was 64 ppm v/v or 64 gm/m^3 (reviewer calculated), the study most likely would support a general label claim that the product repels Formosan and Eastern subterranean termites (but for no more than 1 week). Because mortality rates were not higher than about 40% after one week, even at 100 ppm w/w, the study cannot be used to support a label claim "kills termites."

STUDY 2. Internal FMC Report: Termiticide Soil pH Study (corresponds to Appendix 2 in MRID 462728-01).

Summary of Efficacy Data

Bifenthrin efficacy data were not included in this report.

STUDY 3. Degradation of bifenthrin, chlorpyrifos, and imidacloprid in soil and bedding material at termiticidal application rates. (Baskaran et al., CSIRO Land and W#ater Group, 1999; corresponds to Appendix 3 in MRID 462728-01)

Summary of Efficacy Data

Bifenthrin efficacy data were not included in this report.

STUDY 4. Persistence and Bioavailability of Soil Treatments Against the Desert Subterranean Termite *Heterotermes aureus* in Arizona. University of Arizona Draft Publication (corresponds to Appendix 4 in MRID 462728-01).

Summary of Efficacy Data

The objective of this field study was to evaluate the barrier effectiveness of selected termiticides against *H aureus* using weathered, exposed and covered plots in Arizona over a 5-year period. Field plots were established using a randomized block design. Both covered concrete slab plots and uncovered/exposed plots were included in each treatment. Both residue analysis and bioassays were conducted on soil periodically sampled from each test plot. Results from the residue analysis are given in Table 3. Table 4 shows the results from the bioassay trials.

The initial concentration and the residual soil concentrations are expressed on a weight-weight basis.

Table 3. Concentration of termiticide in parts per million (ppm) at the end of the specified post-treatment period for exposed plots in Tucson, Arizona.

	Initial Concentration	0 mo	12 mo	24 mo	36 mo	48 mo	60 mo
Bifenthrin	**0.06%**	**91 ppm**	**49**	**30**	**28**	**7**	**5**
% remaining		**--**	**54%**	**33%**	**31%**	**8%**	**6%**

Table 4. Associated mortality after 7 and 14 d laboratory bioassays and vertical distance of soil penetrated by *Heterotermes aureus* (Snyder) from termites exposed to 5-cm core samples of exposed termiticide treatments at 24, 36, 48 and 60 months post-treatment.

		% Mortality				Distance tunneled (cm)			
	Rate	24 Mo	36 Mo	48 Mo	60 Mo	24 Mo	36 Mo	48 Mo	60 Mo
Bifenthrin	0.06%	100	73	83	77	0.0	0.0	0.0	2.7
Control	0	11	20	41	32	5.0	5.0	5.0	5.0

Author's Conclusions

Bifenthrin inhibited *H. aureus* tunneling

for 48 mo, but by 60 mo penetration was up and mortality was down. By 60 mo, Bifenthrin had degraded to 5 ppms, adequate to curtail tunneling levels to 05% of those in the other treatments.

Submitter's Conclusions

Residue analysis of bifenthrin-treated soil from exposed plots in Tucson, AZ collected at 60 months post-treatment showed 5.5% of the initial concentration was still present. Lab bioassays of core samples from exposed bifenthrin treated plots at 60 months post-application showed that *H. aureus* was unable to completely tunnel through the 5cm sample.

Reviewer's Conclusions

The results support the conclusions of the submitter; a residual bifenthrin concentration of 5 ppm w/w prevented *H. aureus* from tunneling more than 2.7 cm after 60 mo; however, mortality was only 77% at 60 months.

NOTE: The initial bifenthrin concentration of 0.06% used in the study was expressed on a weight to weight basis whereas the proposed label dilution rate of 0.06% (reviewer calculated) is expressed on a volume per volume basis.

Reviewer's Recommendation

Study does not support a proposed label statement that the product keeps termites away for up to 5 years. If the concentration tested is not substantially different from the label concentration after dilution, and the amount applied was equal to or less than the label application rate, then the study can be used to support label claims that the product kills *H. aureus* termites for up to one year and keeps *H. aureus* termites away for up to 48 months.

Study 5. Summary Report after nine years of field trials installed in Australia at Beerburrum, Queensland State Forest 589, with bifenthrin (FMC 54800) as a soil barrier against subterranean termites. Runko,, CSIRO Entomology, 2004 (corresponds to Appendix 5 in MRID 462728-01)

Purpose:

The objective of these trials was to assess in the field the performance of bifenthrin as a chemical barrier against subterranean termites. The trial design included evaluation of bifenthrin (i) as a vertical barrier treatment where bifenthrin at various rates was incorporated into soil and applied in trenches, and (ii) as a horizontal barrier where bifenthrin at various rates was applied directly to the soil surface. For both the vertical and horizontal barrier trials, the treatments were subdivided into plots that were covered with a moisture barrier and concrete slab and plots that remained uncovered.

Seven dosages of bifenthrin were used in the vertical barrier and six dosages were used in

Location:

The trial was installed in sub-tropical Queensland some 55 km North of Brisbane, (26° 58' S, 152° 54' E) at a site which lies within the Beerburrum State Forest 589 where *Coptotermes acinaciformis* and other subterranean termites are abundant.

The area receives an annual average rainfall of 1438 mm, which falls mainly in the summer months. The soil is a loamy sand (based on Northcote field texture), a pH of 6.08, Electrical Conductivity (EC) of 5.92 ~S/cm and % Total Organic Carbon of 0.379. The temperature ranges from a maximum 35° - 40° C, and minimum of 12° – 16° C during summer, and between max 25°- 30° C, and min 5° – 10° C during winter.

Methodology:

Vertical Barrier Tests (bifenthrin mixed with soil):

The trial involved 12 sets of treatments. Each treatment consists of six replicates spread over four different plots. Each plot is comprised of two parallel trenches 30 cm wide and 30 cm deep., filled with treated soil in compartments 30 cm long alternating with untreated soil in compartments ranging from 30 cm to 75 cm long (Fig 1). Galvanized

plates 40 cm x 40 cm were placed in the trenches to separate the treated and untreated compartments.

The untreated compartments were re-filled with untreated soil. For treated compartments 0.028 m^3 of pulverized soil was mixed with the appropriate volume of 100 g/L EC, diluted to 2.3 L with water[1]. Once mixing was complete, the treated soil was poured into the appropriate compartment and tamped down. A metal coaming was placed on top of each treated compartment, to prevent untreated soil from spreading across it. A billet of susceptible *Pinus radiata* timber 23 cm x 5 cm x 5 cm was driven into the centre of each compartment, its top almost flush with the soil surface. In order to reach the billets in the treated soil, termites would have to traverse at least 10 cm of insecticidal soil.

Six compartments of each of five out of seven concentrations were covered with a polyethylene sheet (moisture barrier) 60 cm x 60 cm and a concrete slab 60 cm x 60 cm and 7.5 cm thick. Six compartments of each of seven concentrations were uncovered, **giving a total of 72 compartments treated with bifenthrin.**

Horizontal Barrier Tests (bifenthrin poured on soil surface):

The trial involved 12 sets of treatments. Each treatment consisted of six replicates spread over four different plots. Each plot is comprised of two 30 cm wide parallel strips of bare soil with surface-treated compartments 30 cm long alternating with untreated soil in compartments ranging from 30 cm to 75 cm long (Fig 2). Galvanized plates 40 cm x 10 cm were placed in the soil to separate the treated and untreated compartments.

The untreated compartments were moistened with 450 ml of water. For treated compartments the appropriate volume of 100 g/L EC was added to 450 ml of water[2] and applied to 900 cm^2 of soil surface by pouring the emulsion through a rosehead of a plastic watering can into a 30 cm square metal frame on the soil surface. A metal coaming was placed on top of each treated compartment, to prevent untreated soil from spreading across it. A board of susceptible *Pinus radiata* timber 10 cm x 10 cm x 1.5 cm was placed on the surface, of each compartment. In order to reach the board on the treated soil surface, termites would have to traverse across 10 cm of surface-treated insecticidal soil or penetrated a layer of at least 5 cm of treated soil (actual depth of penetration of chemical depending on soil type and conditions at the time of treatment).

Six compartments of each of six out of seven concentrations were covered with a polyethylene sheet (moisture barrier) 60 cm x 60 cm and a concrete slab 60 cm x 60 cm and 7.5 cm thick. Six compartments of each of six out of seven concentrations were **uncovered, giving a total of 72 compartments treated with bifenthrin.**

Treatments:

Seven dosages of bifenthrin were used in the vertical barrier and six dosages were used in the horizontal barrier trials with 6 replicate plots per treatment (Tables 5 and 6.)

Table 5. Amount of bifenthrin at different dosage rates and treatments applied in the vertical barrier trial.

Dosage (%)	0.025	0.05	0.075	0.1	0.15	0.2	0.3
Gm AI/m^3 soil	20	40	60	80	120	160	240
Treatment	uncovered + covered	uncovered + covered	uncovered + covered	uncovered + covered	uncovered + covered	uncovered	uncovered

Table 6. Amount of bifenthrin at different dosage rates and treatments applied in the horizontal barrier trial.

Dosage (%)	0.025	0.05	0.075	0.1	0.15	0.3
Gm AI/m² soil	1.25	2.5	3.75	5.0	7.5	10.0
Treatment	uncovered + covered	uncovered + covered	uncovered + covered	uncovered + covered	uncovered + covered	uncovered

Summary of Efficacy Data

Results are shown in Tables 7 and 8.

Table 7. Vertical barrier treatment: Summary of performance by bifenthrin as a vertical soil barrier against subterranean termites; figures indicate the percentage of uncovered plots (6 each per test concentration) penetrated by termites.

	Percentage of uncovered plots penetrated by termites							
# Years after installation	0.025%	0.05%	0.075%	0.10%	0.15%	0.20%	0.30%	Untreated
1	17	0	0	0	0	0	0	74
2	17	0	0	0	0	0	0	90
3	17	0	0	0	0	0	0	99
4	17	0	0	0	0	0	0	89
5	33	0	0	0	0	0	0	75
6	33	17	0	0	0	0	0	79
7	67	17	0	0	0	0	0	79
8	100	17	0	0	0	0	0	81
9	100	17	0	0	0	0	0	82

Table 8. Horizontal barrier treatment: Summary of performance by bifenthrin as a horizontal soil barrier against subterranean termites; figures indicate the percentage of uncovered plots (6 each per test concentration) penetrated by termites.

	Percentage of uncovered plots penetrated by termites						
# Years after installation	0.025%	0.05%	0.075%	0.10%	0.15%	0.30%	Untreated
1	0	0	0	0	0	0	44
2	0	0	0	0	0	0	71
3	0	0	0	0	0	0	75
4	0	0	0	0	0	0	54
5	0	0	0	0	0	0	38
6	33	33	17	17	0	0	57
7	33	67	33	17	0	0	64
8	33	67	33	17	0	0	43
9	33	67	33	50	17	0	50

Author's Conclusions

Vertical Barrier Tests (bifenthrn mixed with soil):

Uncovered

20 gm A.I./m³ (0.025%) - 100% of the compartments (6) have been penetrated: one in the first, one in the fifth, two in the seventh and two in the eighth year;

40 gm A.I./m³ (0.05%) - one compartment was penetrated in the sixth year;

60 gm A.I./m³ (0.75%) - remained unpenetrated;

80 gm A.I./m³ (0.1%) - remained unpenetrated;

120 gm A.I./m³ (0.15%) - remained unpenetrated;

160 gm A.I./m³ (0.2%) - remained unpenetrated.

240 gm A.I./m³ (0.3%) - remained unpenetrated;

Covered

20 gm A.I./m^3 (0.025%) - 100% of compartments (6) have been penetrated; three in the sixth, two in the eighth and one in the ninth year;

40 gm A.I./m^3 (0.05%) – 50% of compartments (3) have been penetrated; one in each of the seventh, eighth and ninth year;

60 gm A.I./m^3 (0.75%) - remained unpenetrated;

80 gm A.I./m^3 (0.1%) - one compartment was penetrated in the seventh year;

120 gm A.I./m^3 (0.15%) – one compartment was penetrated in the eighth year.

Horizontal Barrier Tests (bifenthrin poured on soil surface):

Uncovered

1.25 gm A.I./m^2 (0.025%) - 33% of compartments (2) have been penetrated in the sixth year;

2.5 gm A.I./m^2 (0.05%) - 66% of compartments (4) have been penetrated; two in the sixth and two in the seventh year;

3.75 gm A.I./m^2 (0.75%) - 33% of compartments (2) have been penetrated; one in the sixth and one in the seventh year;

5.0 gm A.I./m^2 (0.1%) – 50% of compartments (3) have been penetrated; one in the sixth year and two in the ninth;

7.5 gm A.I./m^2 (0.15%) – one compartment was penetrated in the ninth year;

15.0 gm A.I./m^2 (0.3%) - remained unpenetrated.

Covered

1.25 gm A.I./m² (0.025%) – 83% of compartments (5) have been penetrated; one in the sixth, one in the seventh and three in the ninth year;

2.5 gm A.I./m² (0.05%) – 50% of compartment (3) have been penetrated; in the seventh and two in the ninth year;

3.75 gm A.I./m² (0.75%) - one compartment was penetrated in the eighth year;

5.0 gm A.I./m² (0.1%) - remained unpenetrated;

7.5 gm A.I./m² (0.15%) - remained unpenetrated;

10.0 gm A.I./m² (0.2%) - remained unpenetrated.

Submitter's Conclusions

Field trial results show that all bifenthrin treatments at 0.05% and higher were 100% effective in preventing termite penetration of both uncovered and covered plots in both the vertical and horizontal barrier treatments for at least 5 years.

Reviewer's Conclusions

Results support the conclusions of the submitter; a residual bifenthrin concentration of 0.05% prevented termite penetration (primarily *Coptotermes acinaciformis*) for 5 years. This study was not conducted with a termite species present in the United States and no justification was provided for bridging data collected on Australian termite species to species present in the US.

Reviewer's Recommendation

The study shows the product, when mixed with soil at an initial A.I. application rate of 64 gm/m^3 (reviewer calculated) keeps termites (primarily *Coptotermes acinaciformis*) away for 5 years.

Study 6. Summary report after fifteen years of field trials installed in southern Australia at Binya, State Forest, NSW, with bifenthrin (FMC 54800) as a soil barrier against subterranean termites. Runko., CSIRO Entomology. 2004 (corresponds to Appendix 6 in MRID 462728-01).

Purpose:

The objective of these trials was to assess in the field the performance of bifenthrin as a chemical barrier against subterranean termites. The trial design included treating trenches **with soil mixed with bifenthrin at one of four concentrations.**

Location:

The site in Binya State Forest near Yenda, was chosen following installation of bait stakes in 1988. It is an area where similar trials of other soil barriers have been installed. The most important species of termite at the site are *Coptotermes acinaciformis* (Froggatt), two species in the *Heterotermes ferox* complex, *Schedorhinotermes reticulatus* (Froggatt).

Methodology:

The trial involves four sets of treatments. Each set comprises a trench 30 cm wide and 30 cm deep, filled with treated or untreated soil in compartments 30 cm long, the treated and untreated compartments alternate. A metal coaming was placed on each treated compartment, to prevent untreated soil from spreading across it. A billet of susceptible *Pinus radiata* timber 23 cm x 5 cm x 5 cm was driven into the centre of each compartment, its top slightly above the soil surface. In order to reach the billets on the treated soil, termites would have to traverse at least 10 cm 0f insecticidal soil.

For each concentration six compartments were treated. Each set was laid out in two parallel lines of six treatments, six insecticidal and six control.

The concentrations of insecticide were arranged in order, lowest to highest, in six cycles, so that the configuration of sets one and three were similar, differing from sets two and four.

Treatments:

Table 9. Amount of bifenthrin at different dosage rates applied to soil in this trial.

Dosage (%)	0.05	0.15	0.3	0.5
Gm AI/m^3 soil	40	120	240	400

Summary of Efficacy Data

Results are shown in Table 10.

Table 10. Summary of performance by bifenthrin mixed in soil and applied in a trench as a barrier against subterranean termites; figures indicate the percentage of uncovered plots (6 each per test concentration) penetrated by termites.

	Percentage of plots penetrated by termites			
# Years after installation	0.05%	0.15%	0.30%	0.50%
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	17	0	0	0
13	17	0	17	17
14	17	0	17	17
15	17	0	17	17

Author's Conclusions

After the 15th year that bifenthrin has been in trial against *C. acinaciformis* in southern Australia, the status of treated compartments is:

40 g A.I./m^3 (0.05%) – 16% were penetrated in the 12th year (one compartment);

120 g A.I./m^3 (0.15%) - remain unpenetrated;

240 g A.I./m^3 (0.3%) - 16% were penetrated in the 13th year (one compartment);

400 g A.I./m^3 (0.5%) - 16% were penetrated in the 13th year (one compartment).

In southern Australia one compartment in the loading of 0.05% was penetrated by termites in the 12th year. One compartment in each of 0.3% and 0.5% loading was penetrated in the 13th year.
No new compartments were penetrated in the 14th or 15th year.

Submitter's Conclusions

Field trial results show that bifenthrin mixed with soil at concentrations of 0.05% and higher were 100% effective in preventing termite penetration of uncovered plots for at **least 11 years**.

Reviewer's Conclusions

Results support the conclusions of the author and submitter; a residual bifenthrin concentration of 0.05% (corresponding to an initial application of 40 gm A.I./m^3) prevented termite penetration for up to 11 years. This study was not conducted in the United States under environmental conditions present in the US and no justification was provided for bridging data collected on Australian species to species present in the US.

Reviewer's Recommendation

The study shows the product, when mixed with soil at an initial A.I. application rate of 64 gm/m^3 (reviewer calculated) will repel termites (*Coptotermes acinaciformis; Heterotermes ferox* complex; and *Schedorhinotermes reticulatus*) for 5 years.

TASK 2 DATA EVALUATION RECORD

STUDY TYPE: Product Performance

MRID 462728-01. Mares, J.T. Efficacy and Degradation of Bifenthrin in Soil for Insect Control. May 4, 2004.

OCSPP 810.3600: Structural Treatments

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